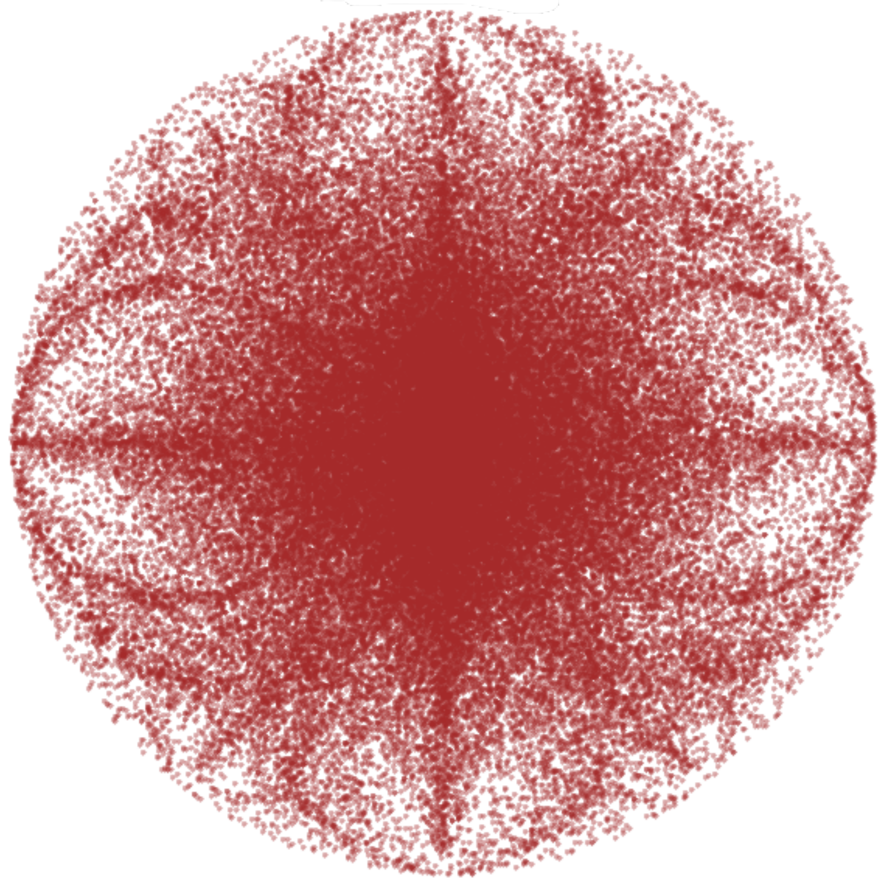
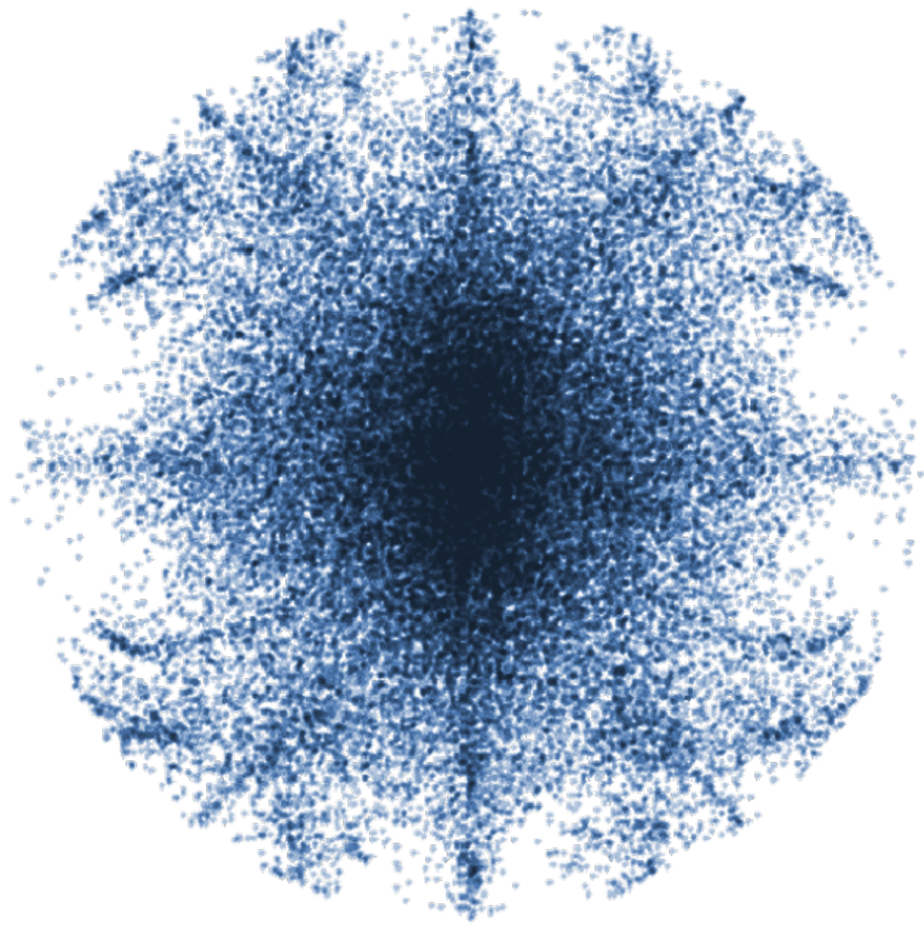
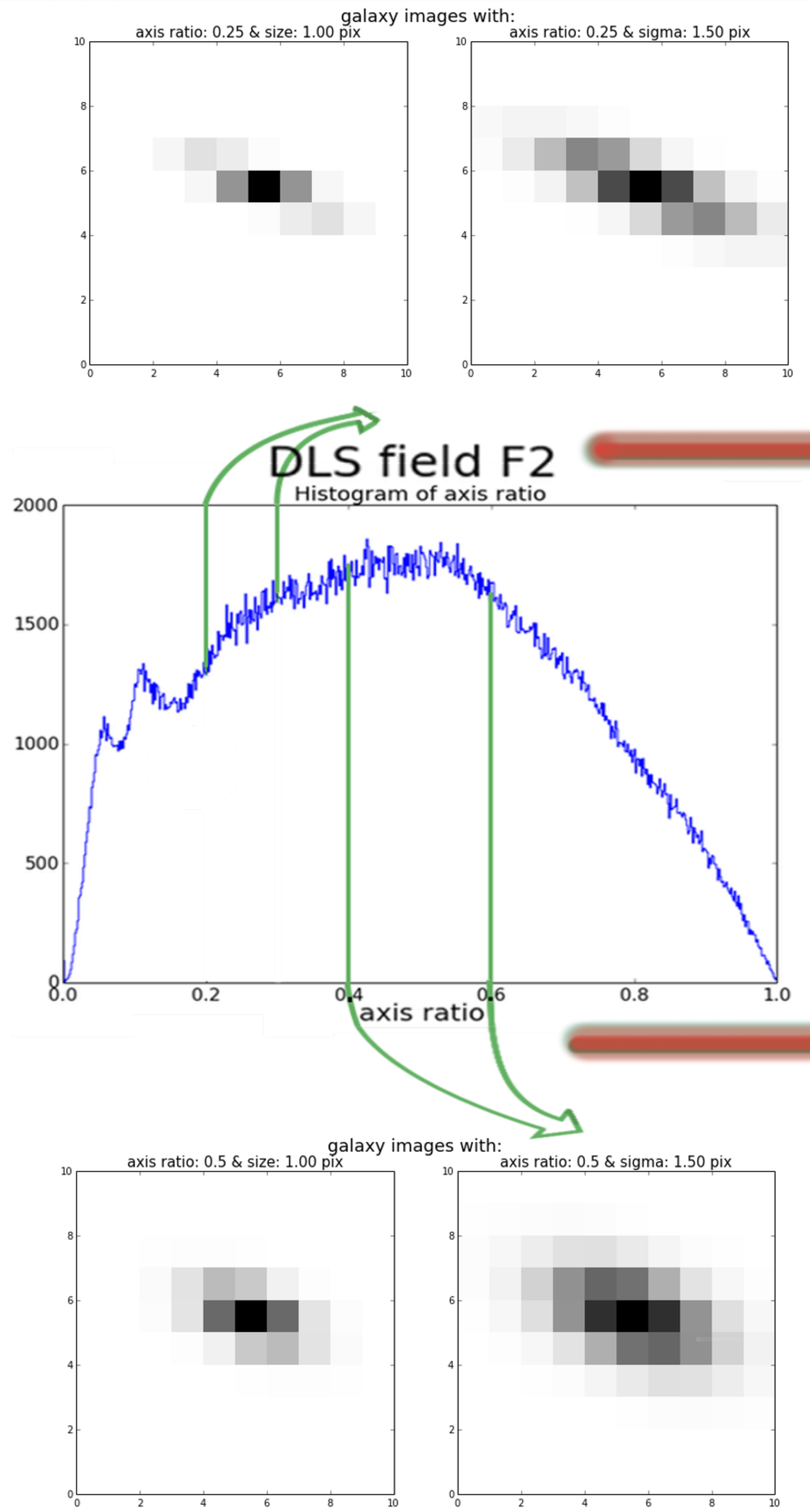
Pixelization Bias

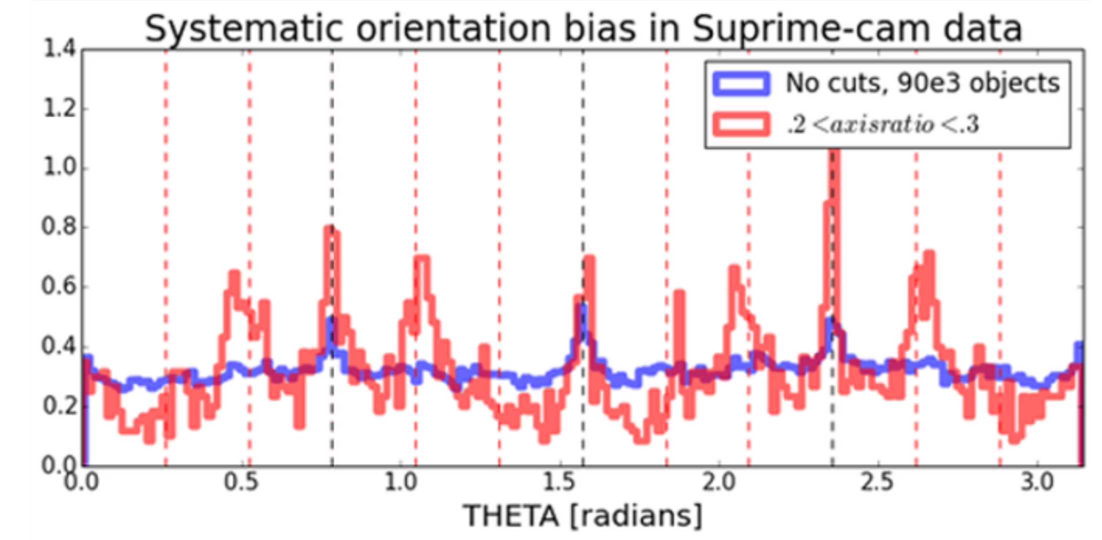
Andrew Bradshaw UC Davis

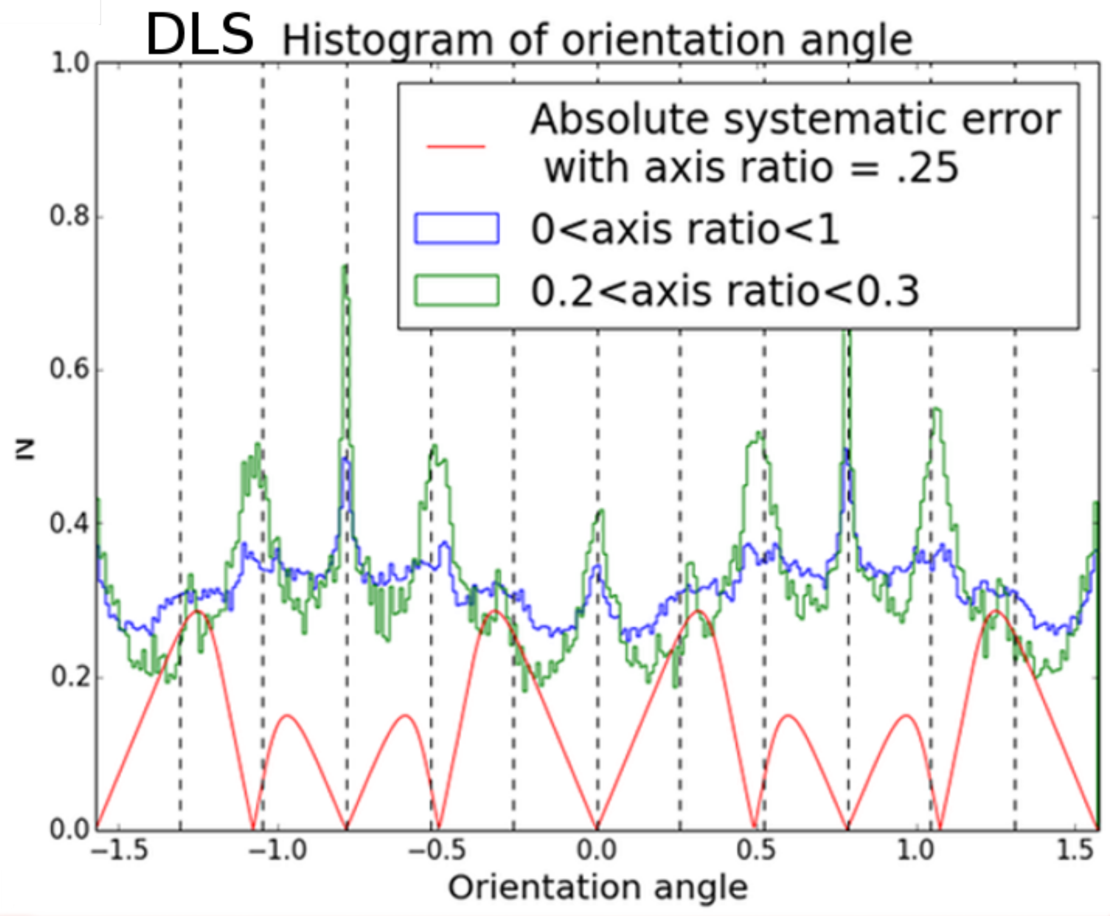


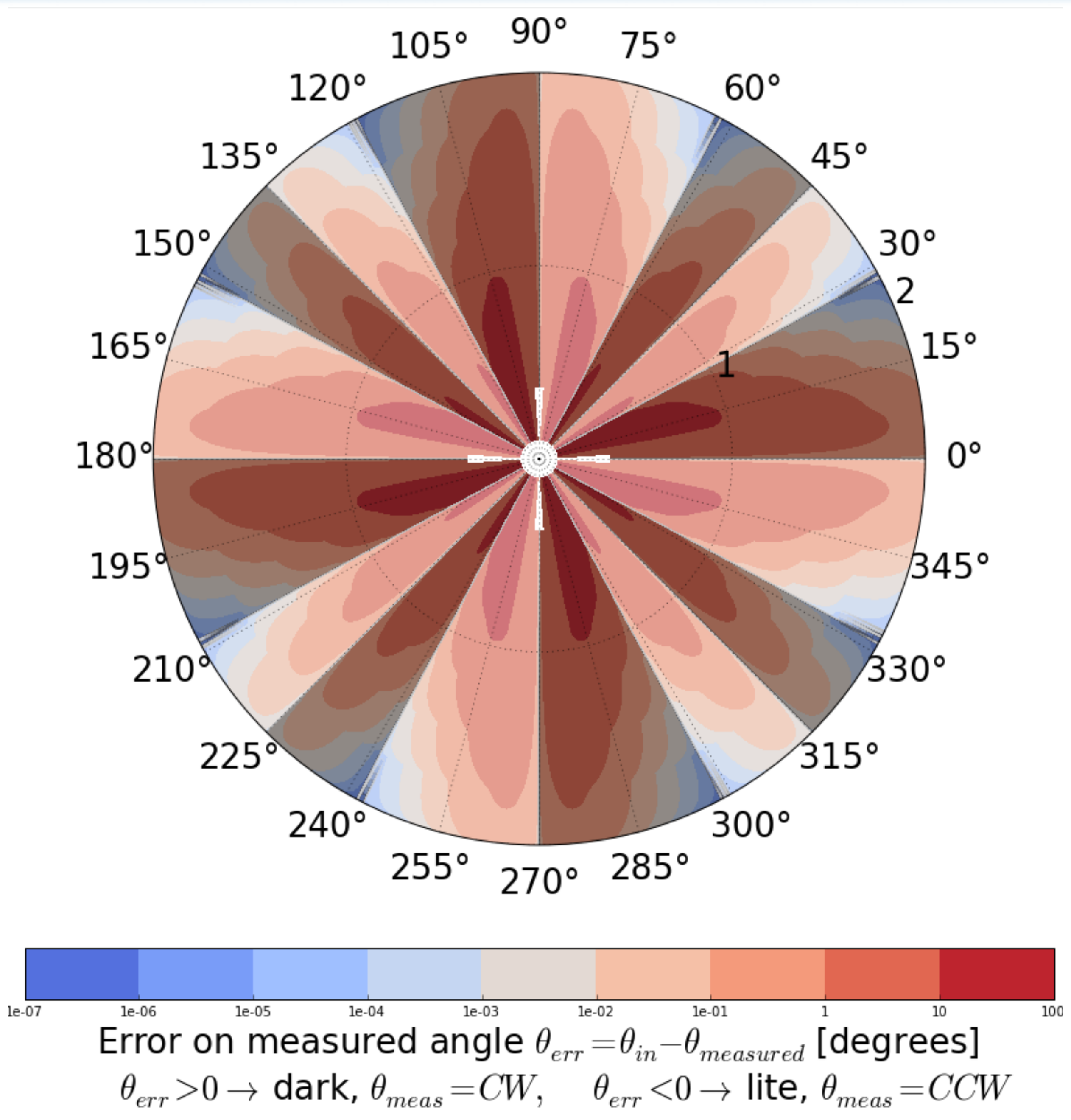


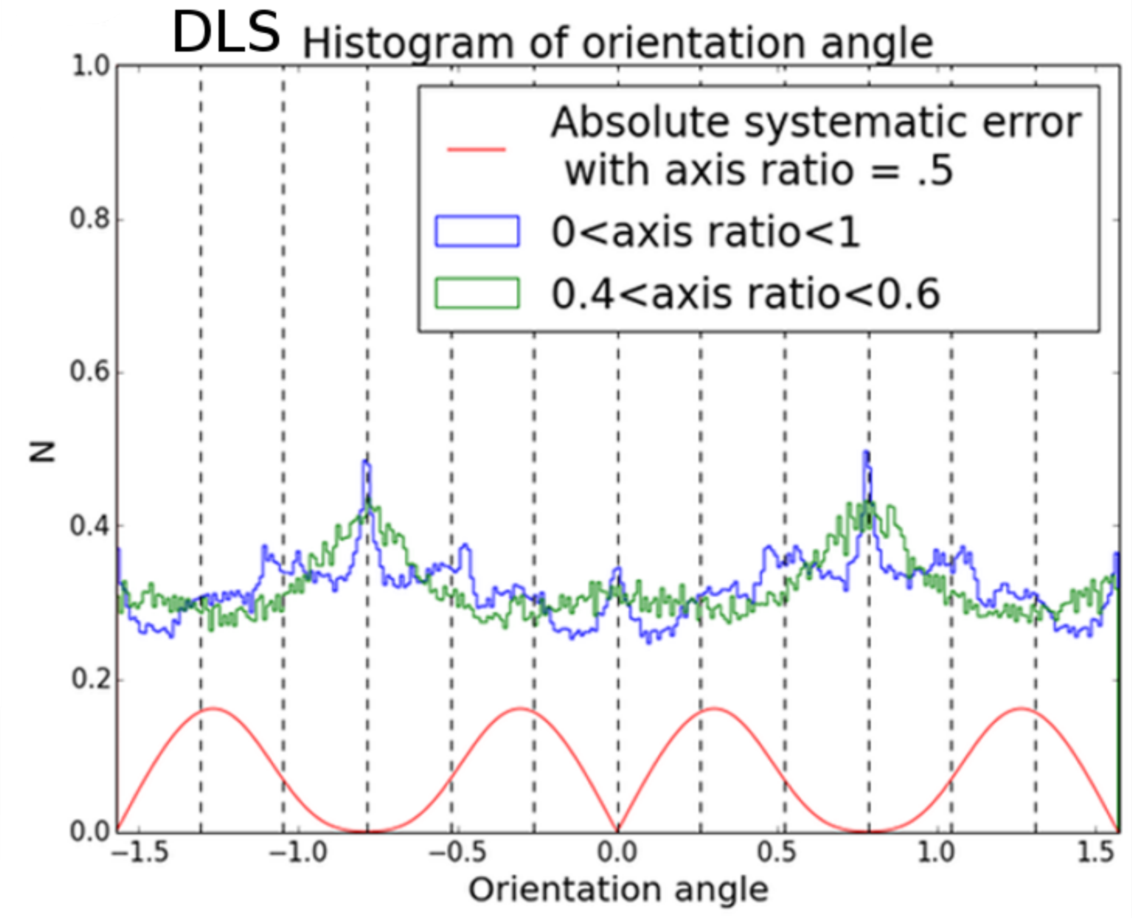
Pixel detectors provide the astronomer with a uniform grid of brightness measurements which are surface brightnesses integrated over the collecting area of each pixel. For very well sampled images, this pixelization affects the PSF in a minor way, and thus the locations and shapes of detected objects are not greatly affected. However, as the size of an object approaches the pixel scale, the pixel binning of it's brightness can create a measurable systematic bias in the calculation of some parameters. Here I present an investigation of the biasing effects of pixelization on the PSF using both simulations and data from two detectors and telescopes, and I discuss how to correct for the bias using proper modeling.

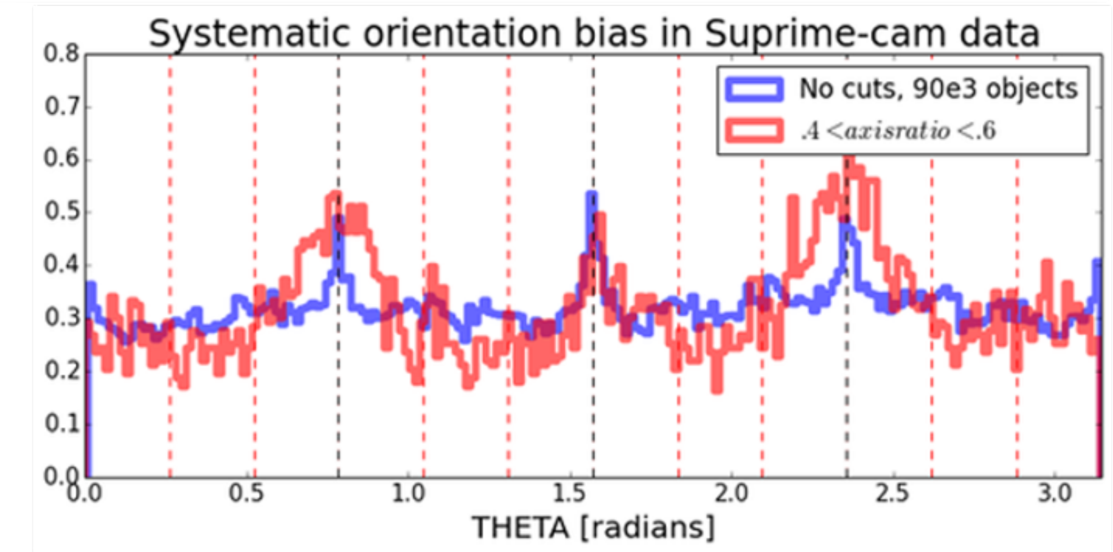


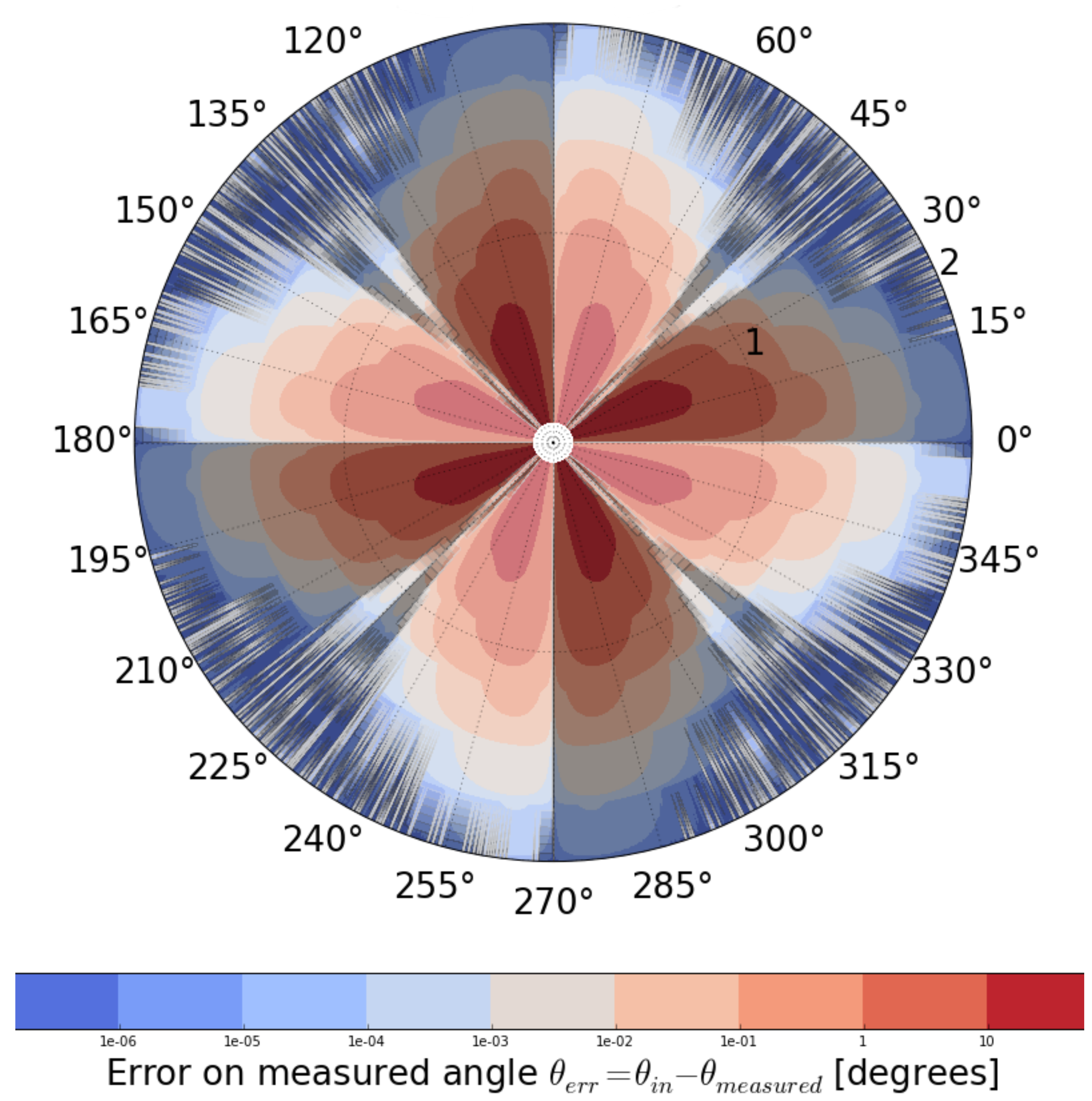












Axis ratio for 700k DLS objects (F2)

The central figure shows a histogram of the axis ratio (b/a) for 700 thousand DLS galaxies. On the top, two example galaxies of axis ratio .25 (very elliptical) are shown, and the bottom illustrates two Gaussian galaxies with b/a=.5 (less elliptical but more common). These simple galaxies are simulated on wide windows with zero noise, and their shapes are calculated using second moments. All of the figures to the right show the pixelization bias for galaxies of these two axis ratio examples.

Orientations of science shapes

These two figures show the observed orientation bias in PSF-corrected galaxy shapes in both the DLS and Suprime-cam data (the effect is clearly similar). Both had shapes fitted with elliptical Gaussians. Also plotted is the absolute systematic error from simulation, see next figures.

Size dependence

These colorful figures illustrate the size (sigma, or width) dependence of the orientation effect on the radial axis. Given an axis ratio and input angle, the simulated galaxy's orientation angle is measured and compared to the input to form the systematic error. Positive (negative) systematic errors are shown in darker (lighter) shades, respectively, and combined they bias galaxies toward preferred angles. The effect rapidly decreases as the size of the input galaxy is increased.